Wildlife Working Papers
Invasive Species Management Project

A. Effects on Management Indicator Species (MIS)

Effects on four of the Forest MIS are discussed in the biological evaluation for the RFSS and SVC species for this project (BE for RFSS and SVC for NNIS). These include northern bobwhite quail (*Colinus virginianus*), yellow-breasted chat (*Icteria virens*), wood thrush (*Hylocichla mustelina*) and worm-eating warbler (*Helmitheros vermivorus*). The only MIS yet to be analyzed is the scarlet tanager (*Piranga olivacea*).

The scarlet tanager is a common summer resident and migrant on the Forest in the Shawnee Hills and floodplains (Forest Plan FEIS, Appendix F). The species is generally considered a canopy-nesting species and prefers mature oak forests for nesting (Bushman and Therres 1988). They are a common nesting species in upland and bottomland forests in the project areas (Robinson 1996).

Direct effects

Since the species nests in late spring and early summer in the forest canopy, there is little chance that the species could be directly affected by any of the three NNIS alternatives.

Indirect effects

Alternative 1 would have long-term (10-15 years out) indirect effects on the species, as invasive plants (IPs) are uncontrolled and would out-compete and replace native overstory and understory plants, including native oaks in the upland and bottomland hardwood forest. This would, in turn, adversely affect nesting habitats, native plant foods and insect prey for the species, resulting in declines in populations for the species in the project areas and across the Forest.

Alternative 3 would result in some indirect adverse effects similar to indirect effects above for Alternative 1, as IPs are not totally controlled. This alternative would also have beneficial effects on upland and bottomland forests in natural areas that are burned and would help maintain native plant foods and insect prey for the species. Net indirect effects on the species would probably be no measurable changes in populations in either the short or long term.

Alternative 2 would have moderate amounts of beneficial, indirect effects on the species, as herbicide applications would control IPs and burning would reduce encroachment and replacement by natives such as sugar maple in oak-dominated upland and bottomland forests in the project areas. This would result in maintenance and improvement of native plant foods, nesting cover and insect prey for the species. Net indirect effects would probably be an increase in populations of the species in both the short and long terms.

Cumulative effects

Geographic boundaries for cumulative effects on scarlet tanager would be all HUC-5 watersheds that include project areas on the Forest. Temporal time-frames for cumulative effects on the species would be 10-15 years, equivalent to the life of the Forest Plan (2006).

Past actions affecting this species across the Forest are identified in the Plan FEIS (SNF FEIS, Chapter 3, 2006). These include agricultural activities and practices, including deforestation for agriculture; succession of oldfields to early- and mid-successional hardwood forests; timber harvests, including all types of silvicultural treatments; lack of timber harvest; some mineral exploration and development; prescribed fire, especially in the last five years, and extensive wildfire in the late 19th and early 20th centuries. Present and future actions would include more prescribed fire, up to 10,000 acres per year

on the Forest and some smaller amounts on private lands and some smaller amounts of timber harvest and management on both the Forest and adjacent private lands in the project area vicinities.

Alternative 1 would have no measurable adverse or beneficial direct effects on scarlet tanager, as few actions and/or changes to the overall hardwood forests would occur. However, this alternative would have a large, indirect, adverse effect on native overstory and understory plant species and thus on food and cover for the species. These would also be the cumulative effects on the species. These cumulative effects on habitats and, subsequently, on populations of scarlet tanager would be more pronounced in the long term (10-15 years out) than in the short term (1-5 years out).

Alternatives 2 and 3 would have no or only minor, adverse direct or indirect effects on scarlet tanager. Both alternatives would have relatively, large beneficial, indirect effects on the species, as native overstory and understory plants and/or native prey that depend upon them are maintained or improved in both alternatives, with the most improvement and beneficial effects resulting from Alternative 2, which includes herbicide applications as well as prescribed burning. These would be the cumulative effects on scarlet tanager from Alternatives 2 and 3, except that beneficial effects on the species would be less pronounced overall as some IPs would persist on adjacent, untreated private forested habitats adjoining the Forest, and would be even less beneficial in Alternative 3, as IPs are not totally controlled.

Summary of Effects on MIS of Invasive Species Management Project

There are five Forest MIS (FEIS, SNF Plan 2006): northern bobwhite quail, yellow-breasted chat, worm-eating warbler, wood thrush and scarlet tanager (BE for RFSS and SVC for NNIS, Wildlife Working Paper for NNIS, 2009). The first four MIS above are Species with Viability Concerns for the Shawnee (BE for RFSS and SVC for NNIS). All of these species occur in all watersheds across the Forest. The above documents (BE for RFSS and SVC and Wildlife Working Papers) for the NNIS analysis include more detailed information and analyses of effects for each species.

Direct and Indirect Effects

Generally no direct effects would occur on these species, as they would not be present or would be able to move away from planned actions so they would not be directly affected by the hand-pulling, torching, herbicide or burning treatments planned in all alternatives.

All would be indirectly affected by planned actions as follows. Alternative 1 would have adverse, indirect effects on native habitats and abundance and distribution of populations for all, as IPs are not controlled or even contained. Alternatives 2 and 3 would have beneficial, indirect effects on habitats and abundance and distribution of populations of all MIS, as native habitats would be improved by burning, which maintains or improves native forest overstories and understories, and herbicide treatments that control and reduce IP spread and replacement of native species and habitats. Most improvements would result from Alternative 2, which includes herbicide treatments.

Cumulative effects

Most past and present actions on private lands generally degraded habitats for all the MIS on the Forest. Most recent Forest management actions have improved habitats for all MIS. Future actions on private lands would continue to degrade habitats for four MIS; however, the amount of habitat degradation would be less than historical amounts due to continuation of conservation programs on adjacent private farmlands. Future actions on Forest lands would improve habitats for all five species, primarily through increased prescribed burning in native forests, oldfields and grasslands.

These past, present and future impacts, combined with the present actions would result in adverse, cumulative effects on habitats and populations of MIS from Alternative 1, as IPs continue to invade and outcompete and replace native overstory and understory plants in their habitats.

Alternative 2 would result in beneficial cumulative effects and on habitats and moderate, beneficial cumulative effects on populations of MIS, as herbicide treatments control and/or stop the spread of IPs on the Forest and subsequent displacement of native overstory and understory plants in hardwood forests, oldfields and barrens. Burning as proposed in Alternative 2 would improve native forest, oldfields and barrens habitats for all MIS, as native plant species are maintained and improved on 10,000 acres of National Forest.

Alternative 3 would result in cumulative effects similar to those of Alternative 2, except that herbicide control of IPs would be replaced by less effective and extensive controls, resulting in less beneficial effects on the native, MIS habitats.

Compliance with the Migratory Bird Treaty Act (MBTA) and Executive Order 13186
Four of the five Forest MIS are migratory birds protected by the Migratory Bird Treaty Act. Executive Order 13186, signed on January 10, 2001, among other things, directed all Federal Agencies to "take certain actions to further implement the Act" (i.e. MBTA). For purposes of this project, the applicable sections of EO13186 are Sec.3.(e): that each agency shall "to the extent permitted by law… and in harmony with agency missions: (1)…avoiding or minimizing, to the extent practicable, adverse impacts on migratory bird resources when conducting agency actions;" and "(6) ensure that environmental analyses of Federal actions required by the NEPA or other established environmental review processes evaluate the effects of actions and agency plans on migratory birds, with emphasis on species of concern."

The Forest has taken, and continues to take, many planning and administrative actions, at both the Forest level and the project-level, to conserve populations of migratory birds across the Forest. The Forest is complying with Executive Order 13186 to the extent practicable to work with the US Fish and Wildlife Service (USFWS) to conserve populations of migratory birds. The Forest consulted with the USFWS on the proposed management of migratory birds (planning record) and received no indication that possible Plan actions do not comply with the MBTA and meet fully the intent of the executive order. The Forest has historically been a leader in Illinois and the Midwest in management to benefit and conserve many species of migratory birds. The 2006 Forest Plan expands (from 1992 Plan acreage) the amount of area on the Forest—99,400 acres—on which management will be emphasized to reduce forest fragmentation and improve forest diversity for migratory birds, especially those that need un-fragmented forest. The 2006 Forest Plan also emphasizes management for both resident and migratory grassland birds with the inclusion of the Large Openlands management prescription and its direction and guidelines.

Standards and guidelines (both at the Forest level and the management prescription level) have been developed in the Forest Plan to minimize potential direct and indirect adverse effects, and to implement actions to enhance habitat and populations of resident and migratory birds.

The best science available was used to develop the 2006 Forest Plan management strategies and direction for migratory birds, which was developed after consultation with recognized avian scientists. The Forest has been, and is, an active partner in the Central Hardwoods Bird Conservation Region. By participating in Partners in Flight, the Forest is coordinating our efforts with the efforts of many other state, federal, local government and private conservation agencies to focus bird conservation efforts where they will do the most good. The Forest Plan employs the latest avian, wildlife and forestry scientific information and input from these avian scientists. Plan management

directions and strategies evolved as countermeasures to identified major threats by insuring forest interior, early-successional forest and grasslands in the region.

Both of the action alternatives proposed and evaluated for this project fully incorporate the standards and guidelines in the 2006 Forest Plan to reduce the potential for adverse impacts to migratory birds from implementation of land management actions, and thus comply with the intent of Executive Order 13186 to protect and conserve migratory birds.

Sec. 3.(e)(1) of Executive Order 13186 also directs federal agencies to "support the conservation intent of the migratory bird conventions by integrating bird conservation principles, measures, and practices into agency activities…" Sec 3.(e)(2) further states that federal agencies shall "restore and enhance the habitat of migratory birds, as practicable."

The Forest has worked toward these goals for decades. The 1992 Forest Plan contained standards and guidelines designed to provide a wide variety of forested habitat conditions, as well as special standards and guidelines for protection and management of specialized habitats (wetlands, caves, glades, riparian, bottomland hardwoods, ponds and shortleaf pine forest) to restore and enhance habitats for a diversity of avian species. The 2006 Forest Plan carried forth many of the essential elements of the 1992 Plan, but with expanded effort directed toward the designation of areas within which habitat conditions would be restored/perpetuated to support interior migratory birds, restore historical open grasslands, and in restoring/ maintaining high quality bottomland hardwood and riparian forest habitat conditions. The standards and guidelines recognize that all successional stages of forest, open habitats and unique ecological conditions are important components of a healthy ecosystem that will support viable populations of all native species.

B. Effects on Ground-nesting Birds

Ground-nesting birds are thought to be more prone to adverse effects from herbicide treatments and prescribed burning due to individuals and nests being within the zones of influence for herbicide and prescribed burning. Three SVC and MIS are ground-nesting birds and occur in all watersheds on the Forest: worm-eating warbler, northern bobwhite quail and American woodcock. Effects on these species would be indicators for effects on ground-nesting bird species in this analysis.

Direct effects

Alternative 1 would have no direct effects on ground-nesting bird species, as none would be directly affected by hand-pulling or torching as part of IP control actions. These species would be able to avoid hand-pulling and torching and, likewise, treatment applicants would be able to avoid known nest sites.

Alternatives 2 and 3 would have no direct effects on ground-nesting species, with the exception of the American woodcock, which begins nesting very early in the spring during burning and herbicide treatment periods. There should be no direct effects of herbicide treatment on nests of early ground-nesting birds such as the American woodcock, as known sites can be avoided by applicants. However, prescribed fire could have adverse effects on some woodcock nests in early spring. Early spring burns in March could cause the species to re-nest in another location or similar locations, shortly after burning. Not all American woodcocks would be directly affected in a particular burn area, as there would still be some unaffected nesting habitats within burns as part of burn mosaics

Indirect effects

Alternative 1 would have adverse, indirect effect on habitats for most ground-nesting birds, as native woody and herbaceous understory vegetation declines in abundance and is replaced by IPs as a result of limited control of IPs. This would result in a loss of nesting cover and native foods for these species.

Alternatives 2 and 3 would have net beneficial, indirect effects on ground-nesting birds from burning of natural areas (about 10,000 acres) and from herbicide treatments of the worst infestations of IPs on Forest. Herbicide treatments of IP as planned in Alternative 2 would greatly reduce the spread of IP on the Forest and this should improve the diversity and abundance of native plants in treated areas of hardwood forests, grasslands and oldfields. Herbicide treatments in Alternative 2 would reduce the spread and decrease the abundance of IPs and their replacement of native food and cover plants. Native plants that provide nesting and hiding cover and foods that ground-nesting birds have adapted to and utilize heavily will increase in abundance and diversity. IP treatments as planned in Alternative 3 would not utilize chemical herbicides and would be less effective at controlling and stopping the spread of IPs. Beneficial effects on native plant habitats for ground-nesting birds would be less than those in Alternative two.

Burning of natural areas in both Alternatives 2 and 3 will result in net improvements of both food and cover plants for the ground-nesting species in years following the burns as native herbaceous understory and woody overstory species that are adapted to fire would benefit. Burning in both alternatives will also reduce some nesting cover such as leaf litter for some ground-nesting birds during the year of the burn. Not all ground-nesting cover would be affected in every burn area due to the mosaics of burned and unburned areas created by prescribed fire applications and prescriptions. Overall, prescribed burning would have measurable, beneficial effects on habitats (improvement of food and cover) for all ground-nesting, bird species.

Cumulative effects

Past and present actions on private lands, especially home and transportation system developments and farming actions, including grazing of forests and grasslands and the clearing of hardwood forests for new crop fields adjacent to the Forest in the project areas have usually had adverse effects on ground-nesting species by elimination of habitats directly, or by increasing habitats that benefit the spread of IPs and invasive animals such as the brown-headed cowbird.

Cumulative effects of Alternative 1, considered with past, present and future effects on adjacent private lands, would be decline in native habitats, with an associated small decline in populations of ground-nesting species, as IPs spread and replace native plants/habitats. Cover for nesting and hiding and foods consisting of native plant parts as well as native insects would decline.

Cumulative effects of Alternatives 2 and 3 would be improvement of habitats for ground-nesting species in years after application of prescribed fire. Alternative 2 would have more beneficial, cumulative effects on habitats for ground-nesting species than Alternative 3, as chemical herbicides would be more effective in controlling and reducing populations of IPs than natural herbicides. Populations of ground-nesting birds would be increased, albeit more in Alternative 2 than in 3. Adverse effects on habitats and individual ground-nesting birds from continued past and present actions on adjacent private lands would dilute the overall, beneficial effects of management actions on the Forest for ground-nesting birds in both alternatives.

C. Effects on Federal Threatened, Endangered and Candidate Species

A detailed analysis of the effects on federally listed threatened, endangered and candidate species is found in the Biological Evaluation for Federal Species for this project (BE for T&E for NNIS) in the project planning record and part of the wildlife working papers.

According to the local USFWS field office (February 2009-USFWS Region 3, T&E website listing), the following federally listed species have ranges that include the Forest Proclamation Boundary: Endangered: gray bat (*Myotis grisescens*), Indiana bat (*Myotis sodalis*), least tern (*Sterna antillarum*), pallid sturgeon (*Scaphirhynchus albus*), fat pocketbook pearlymussel (*Potamilus capax*), pink mucket

pearlymussel (*Lampsilis orbiculata*), orange-footed pearlymussel (*Plethobasus cooperianus*); Threatened: Mead's milkweed (*Asclepias meadii*); Candidate: sheepnose mussel (*Plethobasus cyphyus*) and spetaclecase mussel (*Cumberlandia monodonta*).

Table 1. Summary of Effects for Federally Listed and Candidate Species						
CLASS	**SPECIES**	**COMMON NAME**	**STATUS**	**Alt. 1**	**Alt. 2**	**Alt. 3**
Mollusk	*Lampsilis abruptus*	pink mucket pearly mussel	Endangered (E)	NE	NLAA	NLAA
Mollusk	*Plethobasus cooperianus*	orange-footed pearlymussel	E	NE	NLAA	NLAA
Mollusk	*Potamilus capax*	fat pocketbook pearlymussel	E	NE	NLAA	NLAA
Mollusk	*Cumberlandia monodota*	spectaclecase	Candidate for Federal listing ©	NE	NLAA	NLAA
Mollusk	*Plethobasus cyphus*	sheepnose	C	NE	NLAA	NLAA
Bird	*Sterna antillarum*	least tern	E	NE	NLAA	NLAA
Mammal	*Myotis sodalis*	Indiana bat	E	NE	NLAA	NLAA
Mammal	*Myotis grisescens*	gray bat	E	NE	NLAA	NLAA
Fish	*Scaphirhynchus albus*	pallid sturgeon	E	NE	NLAA	NLAA
Plant	*Asclepias meadii*	Mead's milkweed	Threatened	NE	NE	NE

NLAA = Not Likely to Adversely Affect
NE = No Effect

NLAA was determined for pallid sturgeon and pink mucket, spectaclecase, and scaleshell mussels because effects are considered insignificant and/or discountable. NLAA was determined for Indiana bat and gray bat because effects are considered beneficial, insignificant, and/or discountable. NE determinations were made due to lack of documented occurrences on Forest lands, the project is outside the known or expected range of the species, and/or design criteria were incorporated into the project proposal and will be implemented to protect the species.

Aquatic Species

Least tern, pallid sturgeon and the five mussels species listed above will be combined for this analysis as Aquatic T&E and Candidate Species.

The implementation of the no action, existing condition would have no effect on least tern, fat pocketbook, pink mucket, orange-footed pearlymussel, sheepnose, spectaclecase and pallid sturgeon, since none of the species are known from existing treatment areas and treatments would have little direct or indirect effects on aquatic habitats of these species. The implementation of Alternatives 2-3 may affect but is not likely to adversely affect least tern, fat pocketbook, pink mucket, orange-footed pearlymussel, sheepnose, spectaclecase and pallid sturgeon. This determination was made primarily because it may be possible for direct or indirect adverse effects to occur to individuals. However, for reasons given below, these effects meet the definition of insignificant and discountable.

Several design criteria related to water quality will be implemented to protect these species from potential adverse impacts of treatments proposed in Alternatives 2 and 3. In particular, only formulations approved for aquatic-use would be applied adjacent to wetlands, lakes and streams, following label direction. Mixing of these chemicals will be done at least 100 feet away from these areas to prevent spills and concentrated chemicals from entering water occupied by rare species. Exposed soils will be promptly revegetated to avoid re-colonization by IP and to stabilize the soil. Fueling or oiling of mechanical equipment and mechanically constructed firelines for prescribed burning would occur at least 100 feet from aquatic habitats, caves, and mine openings. In addition, effects from herbicide application within the watersheds could occur, but these effects are considered insignificant and discountable given the implementation of Forest Plan standards and

guidelines and design criteria, the scattered location of treatments within a watershed, and the relatively small individual sites being treated.

Beneficial effects from the elimination or reduction of IP (as proposed in Alternatives 2 and 3) from adjacent terrestrial habitats would be long term. Protecting aquatic habitats and allowing native vegetation to thrive will also benefit various host species that the five mussels rely upon.

Indiana and Gray Bats

The Forest and project areas contain habitat for both the Indiana and gray bats, both of which are endangered species.

Alternative 1 will have no direct, indirect, or cumulative effect on the Indiana bat or gray bat. Alternatives 2 and 3 may affect, but are not likely to adversely affect, the Indiana or gray bat. These effects are considered beneficial, insignificant and discountable. This was determined primarily because smoke could enter caves and fire could burn unknown roost trees. Also, if smoke lingered within the forested areas at dusk when Indiana bats are foraging, it could temporarily displace individuals. The treatment of IP may also be beneficial for the gray and Indiana bat because it will help maintain native habitats and those native insects (prey species) that have evolved with native plants. With the implementation of Forest Plan Standards and Guidelines, along with design criteria for Alternatives 2 and 3, both species would be protected from direct and indirect effects. Consequently, actions proposed in Alternatives 1-3 are not expected to have any significant cumulative effects on either species.

The potential adverse effects associated with prescribed fire are ameliorated by implementation of standards and guidelines for Indiana bats. The following is a list of Forest-wide and Indiana bat standards and guidelines applicable to prescribed fire, and an explanation of benefits for Indiana bats:

- *Prohibit any significant disturbance such as prescribed burning and smoke generation and tree cutting, except for bat habitat enhancements, within approximately 100 feet of a cave entrance or open abandoned mine entrance when occupied by bats (Appendix H, p 286).*
- *FW51.2.1.1 (S) Smoke-management planning is used to control the effects of smoke emissions and meet air-quality standards. During prescribed fires, consideration shall be given to smoke-sensitive areas including Indiana or gray bat hibernacula that may lie downwind of the burn.*
- *FW51.2.1.2 (S) Burns within 0.25 miles of any Indiana or gray bat hibernacula shall be conducted under conditions that will reduce or eliminate smoke dispersing into the hibernacula.*

Implementation of these standards will significantly reduce the possibility of smoke entering hibernacula and impacting hibernating or roosting Indiana bats.

- *FW51.2.1.3 (S) To reduce the chances of affecting maternity roosts and foraging habitats, no prescribed burns shall be done in upland forest from 5/1-9/1 and in bottomland forests from 4/1-9/1. No burning shall be done in forested areas of Oakwood Bottoms during the spring seasons, 3/1-4/1 annually. Only 30% (approximately 1,900 acres) of the Big Muddy bottomlands (approximately 6,200 acres of National Forest) east of the Big Muddy levee shall be burned (blackened) annually during spring burning seasons.*

Implementation of these standards will significantly reduce the potential impacts associated with prescribed burns within the home range of maternity colonies. By limiting the timing and amount of prescribed burning within the Oakwood Bottoms and Big Muddy bottomlands, insect populations should not be significantly affected in any given year to such a degree that there will be adverse fitness consequences for Indiana bats. As prescribed burns will occur in the spring in uplands, tree-

roosting Indiana bats could be adversely impacted. However, these burns will occur early in the maternity season prior to the birth of pups, thus female bats should be able to relocate to other roosting habitats and direct mortality is not anticipated. Fall burns after 9/1 could also adversely impact roosting Indiana bats. However, by this time pups will be mobile and should be able to relocate to other roosting habitats, thus direct mortality is not anticipated.

- *FW51.2.1.4 (S) To reduce the chances of adversely affecting Indiana bat, male roosting habitat within 4km (2.5 miles) of surrounding known hibernacula, no more than 20% of the habitat in this zone shall be burned (blackened) annually. Within 4km-8km (2.5 to 5 miles) surrounding known hibernacula, no more than 50% shall be burned (blackened) annually.*

Implementation of this standard should ensure that insect populations are not significantly depressed around hibernacula in any given year due to prescribed burns. Thus, the fitness of individuals using these areas should not be adversely affected (i.e., insect availability is not expected to be decreased such that the foraging efficiency of those individuals will be decreased). Some burns will occur during the spring and summer which may impact roosting habitat for individuals using this area in the summer. However, these bats are mobile and will be able to locate alternate roost trees readily. Given the small amount of habitat impacted around hibernacula (see analysis in FEIS Appendix F and Appendix B of the Biological Opinion for the SNF Plan) and the relatively small number of individuals exposed, the bats are expected to be able to relocate and fitness consequences are not anticipated. In the fall, larger numbers of Indiana bats occupy the habitat within and surrounding hibernacula. During this time bats are accumulating fat reserves and continue to roost in trees to some extent. Habitat around hibernacula is abundant in comparison to the number of bats utilizing these hibernacula (Appendix B). Prescribed fire may also benefit Indiana bats in many ways. High-intensity fire may create additional snags and potential roost trees for Indiana bats. Opening the understory would reduce clutter around these potential roost trees improving microclimate diversity and foraging conditions. In addition, oak regeneration should occur in response to the fire, leading to long-term potential roosting habitat on the landscape. The benefits would be increased fitness, shortened gestation periods and improved reproductive success. This could ultimately lead to population stability or increase.

Finally, insect abundance in areas has been identified as increasing for some time following prescribed fire, ranging from months to years, (Jackson 2004). While this effect may depend on location and/or time of year, it could lead to higher quality and quantity of the insect base and increased feeding success for Indiana bats. This would lead to an improved energy budget, increased reproductive success and survival, ultimately resulting in population stability or increase.

Mop-up operations include measures to extinguish burning coals and/or trees to preclude fire escape. Burning trees may be felled for this purpose. No additional impacts beyond those discussed above are anticipated as a result of mop-up operations. Forest Plan standards for the removal of dead trees during bat maternity seasons would be followed (Forest Plan, Appendix H).

D. Effects on RFSS Animals

Table 1. Summary of Effects on RFSS and SVC Animals (Details in BE for RFSS and SVC).						
	Alt. 1	**Alt. 1**	**Alt. 2**	**Alt. 2**	**Alt. 3**	**Alt. 3**
Species	**Direct/Indirect Effects**	**Cumulative Effects**	**Direct/Indirect Effects**	**Cumulative Effects**	**Direct/Indirect Effects**	**Cumulative Effects**
Invertebrates						
Spike	No effect / No effect	No effect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect
Carrinate pillsnail	No effect / May adversely effect	May adversely affect	May affect / Not likely to adversely affect / Beneficial effects	Beneficial effects	May affect / Not likely to adversely affect / Beneficial effects	Beneficial effects
Purple Liliput	No effect / No effect	No effect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect
Illinois cave beetle	No effect / No effect	No effect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect
Springtail	No effect / No effect	No effect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect
Cave-obligate isopod	No effect / No effect	No effect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect
Millipede	No effect / No effect	No effect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect
Bousfield's amphipod	No effect / No effect	No effect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect
Indiana crayfish	No effect / No effect	No effect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect
Big-claw crayfish	No effect / No effect	No effect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect
Hubricht's cave flatworm	No effect / No effect	No effect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect
Black sandshell	No effect / No effect	No effect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect
Cavernicolous springtail	No effect / No effect	No effect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect
Short-tailed bactruid	No effect / No effect	No effect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect
cave obligate isopod (*bicrenata whitei*)	No effect / No effect	No effect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect
A cave isopod	No effect / No effect	No effect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect
Anomalous spring amphipod	No effect / No effect	No effect	No effect / May affect / Not likely to	May affect / Not likely to	No effect / May affect / Not likely to	May affect / Not likely to

Table 1. Summary of Effects on RFSS and SVC Animals (Details in BE for RFSS and SVC).						
	Alt. 1	**Alt. 1**	**Alt. 2**	**Alt. 2**	**Alt. 3**	**Alt. 3**
Species	**Direct/Indirect Effects**	**Cumulative Effects**	**Direct/Indirect Effects**	**Cumulative Effects**	**Direct/Indirect Effects**	**Cumulative Effects**
			adversely affect	adversely affect	adversely affect	adversely affect
Packard cave amphipod	No effect / No effect	No effect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect
Subtle cave amphipod	No effect / No effect	No effect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect
Fish						
Redspotted sunfish	No effect / No effect	No effect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect
Bantam sunfish	No effect / No effect	No effect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect
Spring cavefish	No effect / No effect	No effect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect
Reptiles						
Timber rattlesnake	No effect / May adversely effect	May adversely affect	May affect / Not likely to adversely affect / Beneficial effects	Beneficial effects	May affect / Not likely to adversely affect / Beneficial effects	Beneficial effects
Alligator snapping turtle	No effect / No effect	No effect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect
Flat-headed snake	No effect / No effect	No effect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect
Mississippi green watersnake	No effect / No effect	No effect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect
Northern copperbelly water snake	No effect / No effect	No effect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect
Amphibians						
Eastern narrow-mouth toad	No effect / No effect	No effect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect
Illinois chorus frog	No effect / No effect	No effect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect
Bird-voiced treefrog	No effect / No effect	No effect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect
Gray treefrog	No effect / No effect	No effect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect
Birds						
Henslow's sparrow	No effect / No effect	No effect	No effect / No effect	No effect	No effect / No effect	No effect
Cerulean warbler	No effect / May adversely effect	May adversely affect	No effect / May affect / Not likely to adversely affect	Beneficial effects	No effect / May affect / Not likely to adversely affect	Beneficial effects

Table 1. Summary of Effects on RFSS and SVC Animals (Details in BE for RFSS and SVC).						
	Alt. 1	**Alt. 1**	**Alt. 2**	**Alt. 2**	**Alt. 3**	**Alt. 3**
Species	**Direct/Indirect Effects**	**Cumulative Effects**	**Direct/Indirect Effects**	**Cumulative Effects**	**Direct/Indirect Effects**	**Cumulative Effects**
Loggerhead shrike	No effect / No effect	No effect	No effect / No effect	No effect	No effect / No effect	No effect
Swainson's warbler	No effect / No effect	No effect	No effect / No effect	No effect	No effect / No effect	No effect
Bald eagle	No effect / No effect	No effect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect
Northern bobwhite	No effect / May adversely effect	May adversely affect	No effect / Beneficial effect	Beneficial effects	No effect / Beneficial effect	Beneficial effects
Worm-eating warbler	No effect / May adversely effect	May adversely affect	No effect / Beneficial effect	Beneficial effects	No effect / Beneficial effect	Beneficial effects
Wood thrush	No effect / May adversely effect	May adversely affect	No effect / Beneficial effect	Beneficial effects	No effect / Beneficial effect	Beneficial effects
Yellow breasted chat	No effect / May adversely effect	May adversely affect	No effect / Beneficial effect	Beneficial effects	No effect / Beneficial effect	Beneficial effects
Red-headed woodpecker	No effect / May adversely effect	May adversely affect	No effect / Beneficial effect	Beneficial effects	No effect / Beneficial effect	Beneficial effects
American woodcock	No effect / May adversely effect	May adversely affect	May affect / Not likely to adversely affect / Beneficial effects	Beneficial effects	May affect / Not likely to adversely affect / Beneficial effects	Beneficial effects
Mammals						
Little brown bat	No effect / No effect on cave environments / May adversely affect foraging habitats	No effect / No effect on cave environments / May adversely affect foraging habitats	No effect / Beneficial effect	Beneficial effects	No effect / Beneficial effect	Beneficial effects
Northern long-eared myotis	No effect / No effect on cave environments / May adversely affect foraging habitats	No effect / No effect on cave environments / May adversely affect foraging habitats	No effect / Beneficial effect	Beneficial effects	No effect / Beneficial effect	Beneficial effects
Tri-colored bat	No effect / No effect on cave environments / May adversely affect foraging habitats	No effect / No effect on cave environments / May adversely affect foraging habitats	No effect / Beneficial effect	Beneficial effects	No effect / Beneficial effect	Beneficial effects
Rafinesques big-eared Bat	No effect / No effect	No effect	No effect / No effect	No effect	No effect / No effect	No effect
Southeastern myotis	No effect / No effect on their cave environments / May adversely affect their foraging habitats	No effect / No effect on cave environments / May adversely affect foraging habitats	No effect / Beneficial effect	Beneficial effects	No effect / Beneficial effect	Beneficial effects

Table 1. Summary of Effects on RFSS and SVC Animals (Details in BE for RFSS and SVC).						
	Alt. 1	**Alt. 1**	**Alt. 2**	**Alt. 2**	**Alt. 3**	**Alt. 3**
Species	**Direct/Indirect Effects**	**Cumulative Effects**	**Direct/Indirect Effects**	**Cumulative Effects**	**Direct/Indirect Effects**	**Cumulative Effects**
Eastern small-footed bat	No effect/ No effect on cave habitats, may adversely affect cliff roosting habitats	May adversely affect cliff roosting habitats	May affect / Not likely to adversely affect	May affect / Not likely to adversely affect	May affect / Not likely to adversely affect	May affect / Not likely to adversely affect
Eastern woodrat	No effect / May adversely effect	May adversely affect	May affect / Not likely to adversely affect / Beneficial effects	Beneficial effects	May affect / Not likely to adversely affect / Beneficial effects	Beneficial effects
Northern river otter	No effect / No effect	No effect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect	No effect / May affect / Not likely to adversely affect	May affect / Not likely to adversely affect